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JAMMING OF INFRARED GUIDANCE

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ABSTRACT: Rapid developments of infrared guided weapons menaces all kinds of moving targets, so the jamming of all kinds of infrared guided weapons is being actively researched and developed. With regard to the survivability of automatic weapons on the battlefield, some tentative ideas on jamming of infrared guided weapons are proposed.

KEY WORDS: infrared guidance, automatic weapons, jamming.

In future wars, moving targets (automatic weapons, tanks and various armored vehicles) will be menaced with different precision guided weapons (such as infrared-guided, laser-guided, and photoelectrically-guided weapons), which will have a fatal impact on their survival and safety. To protect these moving targets from being attacked by infrared guided weapons and to improve the survivability of ground combat vehicles, many countries in the world are vigorously working on the development of various jamming techniques in counterattacking infrared-guided weapons.

This paper proposes an initial concept on infrared-guided

weapon countermeasures in the hope of increasing the combat capability and survivability of automatic weapons on the battlefield.

1. Infrared Guidance and Infrared Jamming

1.1. Infrared Guidance

Infrared-guided weapons have many advantages such as high accuracy, less likely to be jammed, simple structure, cost-effectiveness, detection ability as well as the capability of attacking ultra-low-flying targets. At present, most infrared-guided missiles used in Western countries are hot-spot guided systems, which were designed and manufactured a couple of decades ago. These weapons operate in wavebands ranging from 1-3 μ m to 3-5 μ m.

In general, infrared missiles now in service are basically passive-guidance systems, which make use of infrared detectors to capture and track the infrared energy radiated from a target in achieving guidance for searching and then attacking the target.

For instance, the high-powered engines built in some battle vehicles including automatic weapons, tanks, etc., can release heat and discharge exhaust gases, and the gun barrels can heat up during firing; in addition, heat can be generated due to the friction between the caterpillar track and the ground when a tank is moving as well as due to the sunshine radiated on the vehicle body and so on. All these areas can be regarded as the target information sources for infrared-guided missiles.

Despite many good features, an infrared guidance system has some shortcomings which can be seen in its fragility under some unfavorable weather conditions (cloud, fog, rain, wind and so on). Thus, it usually requires support from radar guidance,

which lead to the development of radar/infrared dual mode guided missiles.

The majority of these missiles are ground-to-air missiles with a slightly larger dimension, a speed of Mach 2, and a range of 6-7km. Prior to being used, a radar is used to search for the target, followed by infrared tracking, i.e., the operator uses a telescope to aim at the target, and a computer provides the instructions. And then the wireless remote controlled missile is fired at the target. This kind of guidance enjoys a high hit rate.

1.2. Infrared Interference

As we all know, engines in moving targets such as automatic weapons can radiate large amounts of infrared energy, which certainly provides a favorable condition for the infrared-guided system to execute detection and infrared tracking. This can be very helpful in enhancing the target damage probability.

In fact, to efficiently perform deceptive and tempting jamming over the infrared-guided missile and cause it to deviate from the flight path and eventually lose the capability of attacking the real target, the jammer and the decoy must be a thermal emitter much stronger than that of the automatic weapon. So far, dozens of these kinds of infrared jamming approaches can be available, which play a major part in guiding the infrared-guided missile to the jammer so that the real target can be well protected.

It is to be noted that to effectively jam an infrared-guided missile, an electronic reconnaissance and infrared early warning system is equally important and should be applied in discovering the attacking infrared-guided missiles. Technically, it takes the infrared-guided missile only several seconds from launch to

hit the target, that is to say, if a manual search is applied, it will take a considerable time and therefore may lead to a loss of the combat opportunity and eventually, effective jamming will be made impossible.

Hence, the electronic reconnaissance system, infrared early warning system, command control system, and jamming execution system should be integrated and then applied in automatic weapons with high mechanization so that their automatic control capability can be enhanced, and its battlefield survivability can be ensured.

1.3. Infrared Jamming Patterns

(1) Tracer shell jamming infrared guidance. A tracer shell is an infrared decoy, which can generate thermal radiation much stronger than that from the motor of a moving target such as an automatic weapon. In this case, the seeker of the infrared-guided missile will track the tracer shell and miss or deviate from the real moving target. Obviously, this can be considered as a mature and effective jamming method in deceiving the infrared guidance.

(2) Infrared interferometer. The infrared interferometer has become one of the key techniques in winning a war on the modern battlefield. It is actually an active jammer that has been used to arm the military forces by Western military powers.

(3) Smoke jamming. Smoke is an important passive jamming approach. It can effectively jam not only the visible light reconnaissance equipment, but also the guided weapons such as the infrared guidance, laser guidance and TV guidance, etc.

Take the American M-1A tank as an example: it is not only equipped with a smoke launcher, but also has an engine smoke

generation system. Since a high performance thermal imaging sighting device can discover the target by penetrating the smoke, the anti-infrared detection smoke shell is commonly mounted on modern automatic weapons and tanks, which can shield against infrared waves in the 0.3 to 14micrometer range.

At present, a variety of specialized smoke shells have been in the development. For instance, Thompson-Blonde, Inc. has produced a series of new smoke shells, which can generate an effective smoke shield at a wind speed of 5m/s, and the smoke can last 65 seconds. On the other hand, various kinds of smoke not only can be effective in screening the visible light segment of the spectrum, but also can jam various infrared guidance and laser guidance operating in the 1.8 to 2.4micrometer band. According to related information, a multispectrum large-area smoke system was just successfully developed recently in the United States. This system can achieve the shield over the infrared spectrum through executing a 1-h smoke firing task on the battlefield. The emergence of this system has been considered as an effective infrared countermeasure on the modern battlefield.

2. Protective Measures

In future warfare, large numbers of precision-guided weapons such as infrared guidance will be employed, coupled with the enhancement of kill and damage capability. This inevitably pose a grave obstacle for troop survivability. Most importantly, moving targets will become the key targets to be attacked by the infrared-guided and precision guided weapons. Under this circumstance, the following protective measures are to be considered in improving the protection capability and raising the battlefield survival rate:

2.1 Camouflage

Camouflage serves as a way of protecting real targets by exhibiting fake targets, which can be used to protect our armed forces and deceive the enemy. Under the widespread application of infrared-guided and precision guided weapons, correctly using smoke, camouflage, and fake targets can undoubtedly be an effective approach in increasing survivability.

For instance, the camouflage net is a traditional disguise means, but in the past, this camouflage net could only be effective in visible light, and in addition it was very clumsy. Today, the situation has shifted to the development of the light and integrated multi-spectrum camouflage nets. Take the American mini camouflage net as example: it can be placed in the pocket of a soldier's uniform while folded and can be used at any time.

The integrated multi-spectrum camouflage net is referred to as a means with integrated defense capability such as anti-visible light, near-infrared, thermal-infrared, and radar reconnaissance. It is mainly applied to the valuable military targets and will gradually replace the single functioning camouflage net.

2.2. Reduction of Thermal Emitters

With the development of the infrared reconnaissance, detection and guidance, and thermal image processing techniques, anti-infrared detection technique has become more and more important. In addition to the infrared jamming approach, this technique is also intended to suppress the infrared emitters of a weapon system that might be released in the direction of an enemy's infrared detection system. For instance, the engines in moving targets such as automatic weapons can emit thermal exhaust gases that can be a emitter for infrared reconnaissance. Here, the author recommends some approaches that might be useful in decreasing thermal emitters:

(1) Decreasing the thermal emitter. This can be done through modifying engine performance and using engines with low heat dissipation or heat-insulating engines as much as possible.

(2) Improving engine structure. This can be realized through using metal-asbestos-metal intercalated material to insulate heat in order to decrease thermal radiation.

(3) Altering the infrared radiation wavelength. Developing a new type of fuel to reduce the infrared radiation in the exhaust and altering the radiated wavelengths.

3. Conceptual Design of Infrared Guidance Jamming of Automatic Weapons

The engine section and the exhaust gases from various moving targets are all thermal emitters for infrared guidance, and major targets inclined to be attacked by the infrared-guided missiles. How to increase the survivability of moving targets like automatic gun, effectively jam the infrared guidance, and reduce the hit rate of infrared-guided weapons are questions under discussion, for which the author proposes the following schemes:

(1) Modifying the engine exhaust pipe. Special composite materials such as carbon or ceramics can be used to make engine exhaust pipes. An infrared baffle can be installed at the exhaust mouth or the target itself can be made use of to shield the direction of the infrared radiation. Moreover, an infrared attenuation system can be added to reduce the infrared radiation contained in the exhaust. According to related information, the S-shaped exhaust pipe can be designed to filter 90% of the infrared radiation.

(2) Altering the direction of the exhaust stream. Presently, most of the exhaust from various automatic weapons is

at the side of the vehicle body, which is basically located in the center of the engine. Since the exhaust is a major emitter of infrared radiation, once the infrared-guided missile finds this emitter, it will hit the key part of the automatic gun to paralyze its combat capability.

However, if the direction of the exhaust can be altered and moved from the side to the rear, coupled with the placement of insulating material in the exhaust, and extending the exhaust pipe to a distance away from the rear of the vehicle, then this emitter will become a emitter outside the vehicle body. In that case, even if the emitter is hit by the infrared-guided missile, the vital part of the vehicle can remain intact and the automatic gun can continue its battlefield operation.

(3) Increasing the jamming approaches. Apart from the foregoing measures, an additional temperature-increasing device can be installed, with which the foamed high-molecular-weight material such as the micro-sized epoxy resin and polytene resin, etc., containing metallochemical compounds will be heated at high temperatures, and the gasified exhaust will be sprayed out of the vehicle along with the exhaust flow to form a suspension of foamed particles in the air above the vehicle rear. Similarly, by placing materials containing powdered metals such as tungsten, sodium, and potassium that are ionizable in the temperature-increasing device for high-temperature ionization, and then spraying the metals from the vehicle along with the exhaust, a plasma zone will be formed in the air. Both these measures can play a role in screening the emitter (the operation of this system depends on the material) and also can be an ideal all-band passive jamming for the detection system of precision-guided weapons including infrared guidance. They can make the infrared-guided missile miss its path so that the real target could be protected.

4. Conclusions

In summary, as far as moving targets such as automatic weapons are concerned, the really effective jamming technique to the infrared guidance is to try to reduce the weapon's own various infrared emitters. However, this technique is only one of the measures to be adopted in passive countermeasures. Based on the foregoing concept, if an automatic weapon is modified or has a small jammer added to it, passive jamming can be converted to active jamming. In actual application, the combination of active and passive jamming can be seen as a most effective approach in jamming infrared guidance, which can decrease the hit rate of infrared-guided weapons as well as enhance the survivability of automatic weapons on the battlefield.

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